FACTORS AFFECTING THE SUCCESS OR FAILURE OF AVIATION SAFETY ACTION PROGRAMS IN AVIATION MAINTENANCE ORGANIZATIONS

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The objective of the Federal Aviation Administration's (FAA) Aviation Safety Action Program (ASAP) is to encourage air carrier and repair station employees to voluntarily report errors that may be critical to identifying potential precursors to accidents. Under an ASAP, safety issues are resolved through proactive action rather than through punishment or discipline. The goal of this study was to identify factors that may lead to the success or failure of an ASAP. The Maintenance ASAP Questionnaire (MAQ) was developed and distributed to a randomly selected sample of 83,0000 certificated aircraft mechanics. The results of this survey indicate that there is an overwhelming belief among the respondents that the ASAP programs can truly improve safety. The hurdles in building a successful ASAP program are rooted in two key areas: (a) limited interpersonal trust among mechanics, managers, and the FAA inspectors and (b) lack of awareness about the ASAP programs as well as its potential benefits. In addition to higher levels of trust and awareness among the organizations with successful ASAP programs, it was also clear that these organizations had a more collaborative labor-management relationship.

INTRODUCTION

In 1996, Aviation Safety Action Programs (ASAPs) were introduced in the flight domain with the hope of encouraging pilots to disclose their errors and, more importantly, the factors contributing to their errors. With this knowledge, systemic solutions could then be implemented to preclude recurrence (Harper & Helmreich, 2003). In the absence of specific disclosure by pilots, vital information is not available to the air carrier or the Federal Aviation Administration (FAA) and the solutions are not likely to be systemic. In order to encourage pilots to participate in such a program, the FAA developed specific guidance (AC 120-66) for all the parties involved: FAA field inspectors, pilots unions, and air carrier management. As delineated in this guidance material, the FAA is genuinely interested in obtaining safety-related information through this non-punitive program. Generally, air carriers with ASAP programs are very satisfied with their programs and they believe that the program has identified systemic discrepancies that would not have been otherwise discovered.

In an effort to expand the scope of the ASAP programs, the FAA added guidance materials for the maintenance community (AC 120-66A and -66B). Prior to the start of this study, there were twenty-eight air carriers with flight ASAP programs and only six organizations with maintenance ASAP programs. Since the beginning of this study, the number of flight ASAP programs has risen to forty-one and the number of maintenance ASAP programs has risen to ten. Although both programs have increased during the past year, the ratio of flight-to-maintenance programs remains steady at about four-to-one.

In terms of the events reported to the respective Event Review Committees (ERCs), the ratio seems to be about ten-to-one: flight ASAPs receive about ten times as many reports as maintenance ASAPs. Nonetheless, due to the "networked" environment in maintenance versus the "linear" environment in flight (Patankar & Driscoll, 2004), the resources required to investigate and manage the two programs are about the same.

For the purpose of this study, a "successful" ASAP program is defined as the one that has matured to such a level that there is a regular flow of ASAP reports, there are personnel dedicated to maintaining, analyzing, and implementing of these reports, and there is a mechanism established to provide feedback regarding the overall effects or impacts of the ASAP program. Some "highly successful" programs are able to leverage the benefits of similar agreements in their flight, dispatch, and/or cabin crews. An unsuccessful or "failed" ASAP program is defined as a condition wherein there is no signed MOU between the company, labor union, and the FAA regarding an ASAP program—basically, the program does not exist.

The FAA, the maintenance organizations, and the labor unions want to minimize maintenance errors and improve safety. With this ultimate goal in mind, the present study identifies some of the key factors that are likely to lead to a successful ASAP program in aviation maintenance as well as factors that may be preventing them from getting started.

LITERATURE REVIEW

Early interest in proactive non-punitive measures is evident in the Maintenance Resource Management Roundtables conducted at US Airways (Taylor &

Christensen, 1998). An MRM Roundtable, as it was called, consisted of a representative from the company, a representative from the International Association of Machinists and Aerospace Workers, the FAA Principal Maintenance/Avionics Inspector, and the mechanic(s) who committed the error. The tripartite team (FAA, company, and labor union) endeavored to steer clear of the prevalent blame culture (cf. Marx and Graeber, 1994) and sought a better understanding of the causal factors leading to the error. By adopting this approach, the team was successful in winning the labor force's trust and truly implementing comprehensive and systemic solutions. In response to such a program, several key issues were resolved without resulting in an FAA enforcement action against the mechanic or the company. Unfortunately, the roundtable system was practiced at only one company and was difficult to duplicate at other companies because other people (including FAA inspectors and company managers) were not as amenable to such a system. (Taylor & Christensen, 1998).

Mechanics who did not have access to a roundtable discussion, may have had at least two other options: they could either submit a report to NASA's Aviation Safety Reporting System (ASRS) or use the guidance provided in Advisory Circular 00-58 (cf. FAA, 1998) to file a voluntary self-disclosure report. The ASRS report may provide limited protection to the individual reporter, but the reporter's complaint cannot be acted upon by the company management or the FAA because the individual reports are de-identified; however, NASA will provide statistical information to the FAA if a significant number of reports identify the same problem. A self-disclosure report filed in accordance with AC 00-58, on the other hand, will provide additional legal protection and bring the reporter's concern directly to the company management and the FAA. This advisory circular is designed for a generic (not limited to maintenance) reporting of regulatory violations by all individuals as well as organizations. In practice, organizations use this protocol more frequently than individuals. Therefore, this approach is perceived by the industry as primarily an organization-level disclosure rather than individual-level disclosure. The current ASAP program is focused on the individual making the self-disclosure, providing specific legal protection to that individual as well as supporting a collaborative relationship between the FAA, the Company, and the Labor Union.

Philosophically, there seemed to be an agreement between the FAA and the maintenance community that the mechanic who actually commits the error holds key information that is essential to the development of a truly comprehensive solution. Such an agreement is supported by extensive research in the area of error causation (Battles, Kaplan, Van der Schaff, & Shea, 1998; Gambino & Mallon, 1999; Van der Schaff, 1991 cited by Harper & Helmreich, 2003). The erring mechanic has no incentive (other than an ethical obligation) to disclose his/her error unless there was an effective non-punitive process in place.

Reporting Behavior in Maintenance

It is evident from the exponential rise in the number of ASRS reports filed by mechanics since 1996 that mechanics are willing to report their errors (Patankar & Taylor, 2001). In a recent study of reporting behaviors among 178 maintenance personnel in Australia, Fogarty (2003) reported that organizational factors/culture had a strong influence on the individuals' willingness to report maintenance errors. Fogarty concluded "employees were more likely to report mistakes in situations where management is communicative, open, and committed to safety values." In a similar study, Harper and Helmreich (2003), listed the following as factors that may influence an individual's willingness to report their own error: (a) mandatory versus voluntary system, (b) reporter protection, (c) ability to affect change, (d) fear of litigation and disciplinary action, (e) attitude toward the use of current reporting systems, (f) ease of use of the new/proposed system, (g) personal responsibility to address changes, and (i) management's endorsement of the new/proposed reporting system. The Maintenance ASAP Questionnaire (MAQ) developed for this study provides an opportunity to specifically test the mechanics' willingness to report their own errors—among a national sample.

Trust Between Mechanics and Managers

Interpersonal trust between mechanics and managers has been studied and extensively reported by Taylor and Christensen (1998) and Patankar and Taylor (2004). Based on these studies, it is known that there is a wide variation in such trust among the various maintenance organizations—interpersonal trust tends to be higher in smaller organizations and military units and lower among larger organizations—the range of trust values seem to indicate that up to a third of the mechanics don't tend to trust that their supervisors will act in the interest of safety.

Considering that interpersonal trust among mechanics, managers, and FAA inspectors was mentioned repeatedly during the focus-group discussions conducted earlier (Patankar & Driscoll, 2004), it was essential to include questionnaire items

associated with the "supervisor trust and safety" scale (Taylor & Thomas, 2003) in the MAQ.

METHODOLOGY

The Maintenance ASAP Questionnaire (MAQ) was developed from the responses to a series of focus-group discussions held at three organizations with ASAP programs and three organizations without ASAP programs (cf. Patankar & Driscoll, 2004).

A total of 104 items were created and the participants were asked to rate their level of agreement with each item on a 5-point Likert-type scale: 0= not applicable or don't know, 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, and 5= strongly agree.

All participants were expected to respond to the first 20 items; only the FAA inspectors were expected to respond to items 21-36; only the employees of organizations with ASAP programs were expected to respond to items 37-68, and only the employees of organizations without ASAP programs were expected to respond to items 69-104. Considering the similarities and differences in the items that each group (FAA inspectors, employees from organizations with ASAP programs, and those without ASAP programs) responded to, some common and some different scales emerged through subsequent factor analysis.

Currently, there are no known means to clearly establish, or even estimate, the number of FAA certificated mechanics and managers working for air carriers or approved repair stations. As of January 1, 2004, the FAA's airman certificate database contained 230,880 Aircraft Mechanic certificate holders; however, there is no way of determining exactly how many of them are actively working as mechanics. Assuming that over 100,000 Aircraft Mechanic certificate holders are likely to be working for either an air carrier or a repair station, a minimum of 400 responses were required—"beyond a certain point (N=5,000), the population size is almost irrelevant and a sample size of 400 will be adequate" (Gay & Airasian, 2003, p. 113). As with any other survey, another obvious limitation of this study is that survey respondents tend to "self-select"—people who are interested in responding are likely to respond; to what extent the sample size is actually representative of the total population continues to be a matter of debate. Nonetheless, every effort was made to reach a diverse, and fully representative, population.

In order to minimize the perception among the participants that this study is either a "company survey," a "union survey," or an "FAA survey," the FAA's Airman Certificate database (publicly available for download from the FAA's website) was used to construct a stratified sample consisting of randomly selected participants from each state in the country. The total population of FAA certificated mechanics was sorted by states and ten times the required sample size was selected. For example, the state of Alabama has 3,468 FAA-certificated aircraft mechanics with A&P ratings. According to Gay and Airasian (2003, p. 113), a sample of 240 responses would be its statistically adequate representation. In order to maximize the probability of receiving 240 responses, 2,400 subjects were selected from the state of Alabama. In total, approximately 83,000 questionnaires were mailed out nationwide. All questionnaires were mailed to the participants' home addresses and they were provided with a reply-paid envelope to return the questionnaires directly to Saint Louis University.

RESULTS

A total of 5,022 responses, from all fifty states, were received: 1,548 of the respondents were from organizations with ASAP programs, 2,920 respondents were from organizations without ASAP programs, and 124 respondents were FAA inspectors; 430 respondents did not know whether or not their organization had an ASAP program.

Overall Comparison (All respondents)

A factor analysis of the first twenty items on the MAQ resulted two scales: *willingness to report errors* and *supervisor trust and safety*. On the overall willingness to report one's errors, there was no statistically significant difference between companies with ASAP programs and those without ASAP programs. Significance tested was at 0.05 level and the Cronbach's alpha for this scale was 0.60.

On the supervisor trust and safety scale, employees from organizations with ASAP programs tend to trust their supervisors significantly more than those from organizations without an ASAP program ($p < 0.01$). Cronbach's alpha for this scale was 0.79.

Overall, we see that maintenance personnel are quite willing to report their errors; regardless of whether or not they have an ASAP program. However, when there is an ASAP program, there is a higher level of trust in the management—trust that the management will act on safety suggestions.

FAA Inspectors Only

Analysis of the items posed to FAA inspectors revealed two new scales, in addition to the ones described earlier: perceived importance of ASAP programs (Cronbach's alpha = 0.92) and perceived effects of ASAP programs on enforcement abilities (Cronbach's alpha = 0.84).

About 40% of the FAA inspectors think that ASAP programs are important; another 40% are

somewhat undecided—perhaps, this population could be convinced of the advantages of ASAP programs if better training materials were to be made available. Now may be a great "window of opportunity" to shift the perception about ASAP programs from neutral to positive.

High scores on the perceived effects scale would have indicated that the FAA inspectors have resources to support local ASAP programs, they are willing to let a mechanic learn from his/her errors without resorting to punitive actions, they would not necessarily write fewer violations because of the ASAP program, and they generally don't believe that their enforcement capabilities are compromised. However, most respondents scored low in this scale.

ASAP programs represent a fundamental shift in the way FAA administers safety and compliance. About 47% of the respondents to the perceived effects scale are undecided and need to be better convinced of the effects of ASAP programs on their ability to issue enforcement actions as well as overall change in philosophy—from compliance to collaboration. Considering that the FAA wants to move toward a collaborative error reduction program, about 70% (includes the ones who indicated "neutral," "disagree," or "strongly disagree") of its inspector workforce needs to be better informed regarding the philosophical change that needs to take place.

Participants from Organizations With ASAP Programs

Based on 1,548 responses in this category, four new scales (in addition to the willingness to report errors scale and the supervisor trust and safety scale) emerged: ASAP programs are likely to improve trust (Cronbach's alpha = 0.90), ASAP programs are being used at their maximum potential (Cronbach's alpha = 0.86), ASAP programs receive adequate support from supervisors and coworkers (Cronbach's alpha = 0.85), and ASAP results need to be communicated and the protocol needs to be standardized (Cronbach's alpha = 0.71).

About 54% of the respondents (from organizations with ASAP programs) think that ASAPs are likely to improve trust; about 14% of them don't think that the ASAP programs would improve trust.

Just over 44% of the respondents don't seem to think that their current ASAP programs are being utilized to their maximum potential; about 12% of the respondents do think that their programs are close to full potential. The factors that would lead to better utilization of the maintenance ASAP programs include leveraging with flight and dispatch programs as well as improved communication/dissemination of success stories, and training regarding ASAP acceptance criteria.

Even at organizations with ASAP programs, about 32% of the employees believe that they don't get enough support from their superiors—leads, supervisors, and senior management.

About 71% of the respondents believe that there needs to be a strong communication regarding ASAP programs, including publicizing of the success stories and standardizing the process further.

Participants from Organizations Without ASAP Programs

The next sample consisted of employees from organizations without ASAP programs (n=2,920). In addition to the two basic scales regarding willingness to report and supervisor trust, this sample also revealed the level of difficulty in buying into the benefits of ASAP programs (Cronbach's alpha = 0.92), reported on the state of organizational climate at the time of the survey (Cronbach's alpha = 0.87), and level of awareness about, or interest in, ASAP programs (Cronbach's alpha = 0.74).

About 50% of the respondents agree with the items that tend to value the benefits of an ASAP program. Therefore, one could say that even in companies without ASAP programs, many people believe that ASAP programs have some benefits to offer. Since these results are from organizations without ASAP programs, it is not surprising that about 36% of the respondents did not know about the benefits of ASAP programs, 12% of the respondents were neutral, and 2% of the respondents did not seem to value any benefits of the ASAP program.

About 59% of the respondents disagree that they have a poor organizational climate. Therefore, one could say that just because an organization does not have an ASAP program, it does not mean that the organization is suffering from a poor or unhealthy safety climate.

A low or negative response on the awareness scale indicates that the general awareness about ASAP programs is low among these respondents. About 42% of the respondents disagree that they have a high level of general awareness about ASAP programs and that they have taken the effort to either review their own company's pilot/dispatch ASAP program or have visited other company's programs. If those who clearly indicated that they either did not know about the subject or that they thought that the questionnaire item was not applicable to them are combined, over 92% of the respondents (again, these respondents are from organizations that do not have ASAP programs) do not have a high level of awareness about ASAP programs.

DISCUSSION

Generally, there seems to be a high willingness to report errors; yet, there is also an overwhelming degree of mystery about ASAP programs. This is a great opportunity for the aviation maintenance industry to publicize the benefits of ASAP programs through dissemination of success stories and frequent open discussions with the mechanics from various line and base maintenance stations.

Since this survey indicates that organizations with ASAP programs have a higher degree of interpersonal trust and the overall maintenance community is struggling to raise this trust level in order to improve both quality of maintenance as well as the overall work environment, it would be worthwhile for companies to use collaborative programs such as ASAP to improve trust between mechanics, managers, and FAA inspectors.

Another important point to consider is that a substantial proportion of the respondents are "on the fence" regarding the benefits of ASAP programs—if such programs are to gain further momentum and achieve their full potential, this undecided population will need further proof and convincing that the ASAP programs are actually producing systemic changes without penalizing the reporters. Open meetings, traveling "road shows," periodic status updates, dissemination of success stories through newsletters, and an overall advertising of the various changes effected by ASAP programs could lead to increased awareness of its benefits as well as increased trust in the process.

Also, field observations, focus-group discussions, and analysis of select MAQ items tend to indicate that there is limited leveraging of ASAP data across flight, maintenance, and dispatch groups. Any attempts to foster such tripartite leveraging could lead to novel, synergistic advances in safety and quality.

CONCLUSIONS

In conclusion, the factors that tend contribute toward a successful ASAP program in aviation maintenance organizations are as follows:

- There is a significantly higher level of trust between mechanics and their supervisors
- End-users perceive ASAP programs to be very valuable in improving the overall safety of the industry
- Good communication about the ASAP program and a standardized or a well-understood report handling process exists

Factors that contribute toward the failure of an ASAP program in aviation maintenance organizations are as follows:

- There is a significantly lower levels of trust between mechanics and their supervisors
- End-users don't seem to see a significant benefit in having an ASAP program—it is likely that they are satisfied with their internal error/hazard reporting program
- There is a severe lack of awareness about ASAP programs

Ultimately, one could combine the above success/failure factors into two key themes:

- Level of employee-management-FAA trust
- Level of awareness about ASAP programs

Focus group discussions on this topic indicate that this trust is influenced by experience with internal safety programs, success with past safety programs, and general labor-management relationship. Awareness, on the other hand, is a matter of consistent and concerted advertising of the effects of ASAP programs as well as soliciting of feedback to improve the program.

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